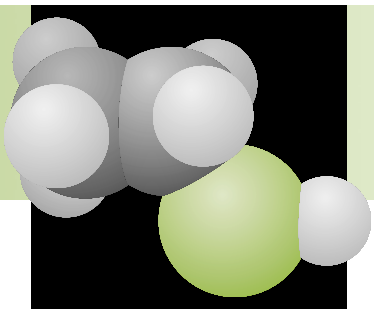
CHEMICALS

Project Fact Sheet



SEPARATION OF HYDROGEN/LIGHT HYDROCARBON GAS MIXTURES

BENEFITS

- Energy savings of 1.14 Tillion Btu per year for an individual plant
- Reduces waste from process gas streams
- Achieves reuse value 2 to 3 times greater than fuel value
- Decreases cost of production by $500,000 per year for an individual plant

APPLICATIONS

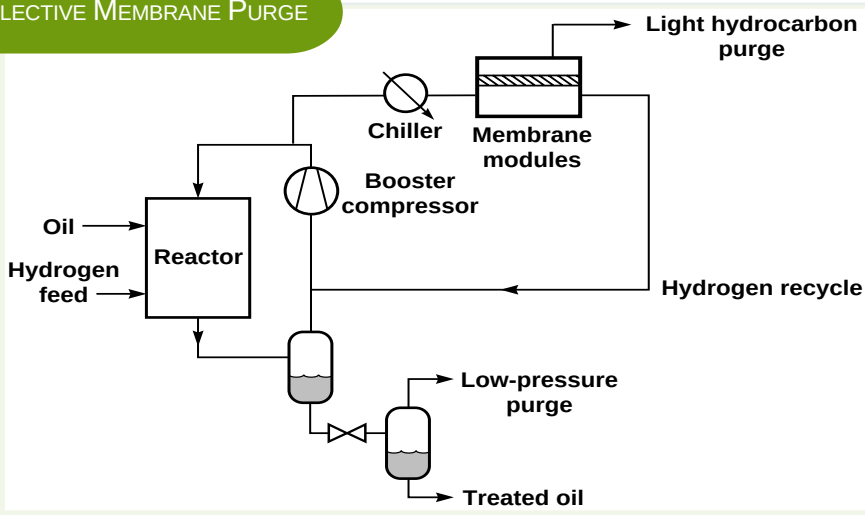
This new membrane system to separate hydrogen and light hydrocarbons can be applied to a wide variety of industrial off-gas streams. Three promising streams for early adoption of this technology are petrochemical hydrogenation vent streams, pressure swing adsorption tail gas, and refinery hydrotreater-hydrocracker purge gas. These resources are currently used as low value fuel.

MEMBRANE RECOVERS HYDROGEN FROM HYDROCARBON GAS MIXTURES FOR USE AS CHEMICAL FEEDSTOCK

Process and off-gas streams containing hydrogen and light hydrocarbon gas mixtures are produced throughout the refinery and petrochemical industries. These streams are generally reused as low value fuel feedstock since economies of scale do not allow conventional separation technologies to be employed. Separating the individual components of the stream would allow them to be reused as chemical feedstocks with two to three times the fuel value. Currently, the two most common processes for separating gas mixtures are cryogenic condensation and pressure swing adsorption. These are not economically viable for dealing with low volume petrochemical off-gas streams or streams containing less than 60 to 70 percent hydrogen.

Project partners will develop and demonstrate a membrane separation process that efficiently and economically separates low volume, low percentage hydrogen and light hydrocarbon gas mixtures. The key to the proposed process is a new membrane that retains hydrogen and selectively permeates methane, ethane, and higher hydrocarbons. Project partners are developing membranes that are able to permeate hydrocarbon gas mixtures, concentrating hydrocarbons on the low pressure side of the membrane and leaving hydrogen on the high pressure side of the membrane. Most importantly, the hydrogen gas can be returned to the process without recompression.

SELECTIVE MEMBRANE PURGE



Flow scheme of a hydrocracker process fitted with a selective membrane system that preferentially permeates light hydrocarbon gases and reduces hydrogen loss from the hydrogen recycle loop.

Project Description

Goal: This project will develop a hydrocarbon-permeable, hydrogen-impermeable membrane system to separate hydrogen and hydrocarbon gas mixtures. Project partners will utilize a unique design approach to acheive an economical process.

Progress and Milestones

Early project research with rubbery polymer membranes, such as silicone rubber, showed that the polymer membranes could provide greater methane/hydrogen selectivity and higher hydrogen permeability than alternative materials.

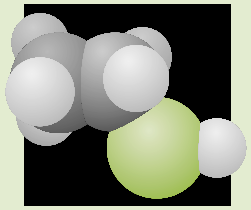
In bench-scale lab testing, rubbery materials and polymethylpentyne membranes successfully performed a methane/hydrogen mixed gas separation with a high selectivity.

Future research will demonstrate technical and economic feasibility by first using small diameter modules at pilot scale to obtain process design data, and then using commercial scale modules in a field demonstration. The following are the targeted objectives:

- Create membrane database and develop predictive process model for computer simulations
- Develop membrane and spiral modules to house the rubbery membrane
- Test bench-scale modules with industrial model gas mixtures
- Design and evaluate industrial-scale processes
- Test industrial-scale modules in a pilot system at a field site

Commercialization

Membrane Technology and Research (MTR) will analyze specific plant applications and perform process design and economics calculations to determine the overall benefit to the end user. MTR will use this information to initiate the commercialization of these new membrane systems for hydrogen/light hydrocarbon separation. MTR already produces and sells rubbery spiral-wound membrane modules on a commercial scale.



Project Partners

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